

# Research: Subtraction Facts 0 to 9

## Study 1

### Overview

A field test was conducted that involved 22 teachers and 109 elementary students who were experiencing difficulties learning math. This student group included 102 students with learning disabilities (LD), 5 students with emotional disabilities, and 2 students who were at-risk for school failure. The field test took place in seven school districts in both small-group (less than 7 students) and larger group (7 to 18 students) instructional arrangements. The teachers were trained to use programs in the Strategic Math Series. Different groups of students were taught addition facts, subtraction facts, multiplication facts, and division facts, depending on their needs. Three types of measures were gathered: student performance on a math-facts acquisition test (number of problems solved correctly with no time limit); student performance on a word-problem test; and student performance on a fluency test (number of digits correct per minute).

### Results

The 14 students who received instruction in the Subtraction Facts 0 to 9 program earned a mean score of 17% on the subtraction acquisition pretest and a mean score of 95% on the posttest. The students earned a mean score of 28% on the subtraction word-problem pretest and a mean score of 84% on the posttest. With regard to fluency, the students produced an average of 11 digits correct per minute during the first abstract lesson and 24 digits correct at the completion of the program. On the follow-up generalization measure, in which students were asked to apply the DRAW Strategy to subtraction facts that had not been taught (i.e., subtraction 10 to 18 facts), students earned a mean score of 92%. The generalization measure was administered 3 to 5 days after instruction ended by examiners unknown to the students in school locations other than their typical classroom. On the follow-up fluency measure, also administered 3 to 5 days after instruction ended by unknown examiners in different locations, the students' mean fluency rate was 18 correct digits per minute.

### Conclusions

The results show that students with learning difficulties in math are able to learn basic subtraction facts and to solve associated word problems through use of the Subtraction 0 to 9 program. The students acquired subtraction knowledge and improved their ability to solve subtraction facts with fluency. They also generalized the DRAW Strategy to novel subtraction problems, to persons other than their math teacher, and to settings other than their typical classroom with high accuracy. Students also generalized their fluency with the subtraction facts to new individuals within new settings at levels that exceed initial baseline rates.

### Reference

Mercer, C. D., & Miller, S. P. (1992). Teaching students with learning problems in math to acquire, understand, and apply basic math facts. *Remedial and Special Education*, 13(3), 19-35, 61.

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## Study 2

### Overview

The purpose of this study was to test the effects of a graduated word-problem instructional sequence in teaching students to solve word problems. This sequence entails first teaching students to solve a problem that contains a few words, then a problem containing a phrase, a sentence, and next a paragraph. Finally, students are taught to solve word problems containing a paragraph that includes extraneous information and to write their own word problems. This sequence is used throughout the Strategic Math Series. It was specifically tested in this study with Subtraction Facts 0 to 9 instruction.

Student participants were 13 students with learning disabilities in math. Their ages ranged from 7 to 9 years. They were taught Subtraction Facts 0 to 9 by four special education teachers who were regularly assigned to teach them in either self-contained classes or resource rooms.

### Results

On the pretest, the students' mean score was 17% on the computation problems. They did not solve any of the word problems correctly. On the posttest, the students' mean score on computation problems was 95%. Their mean score on paragraph word problems without extraneous information was 100%, on paragraph word problems with extraneous information was 86%, and on writing their own word problems was 91%. Thus, their overall mean score for these three types of word problems was 92%. All of the teachers indicated that they would use the program again.

### Conclusions

This study indicated that the graduated word-problem sequence is successful in teaching students with learning disabilities in math to solve subtraction word problems at a high level of competence. Their performance improved with regard to computation problems and different kinds of word problems, including writing their own word problems.

### Reference

Miller, S. P., & Mercer, C. M. (1993). Using a graduated word-problem sequence to promote problem-solving skills. *Learning Disabilities Research & Practice*, 8(3), 169 – 174.

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## Study 3

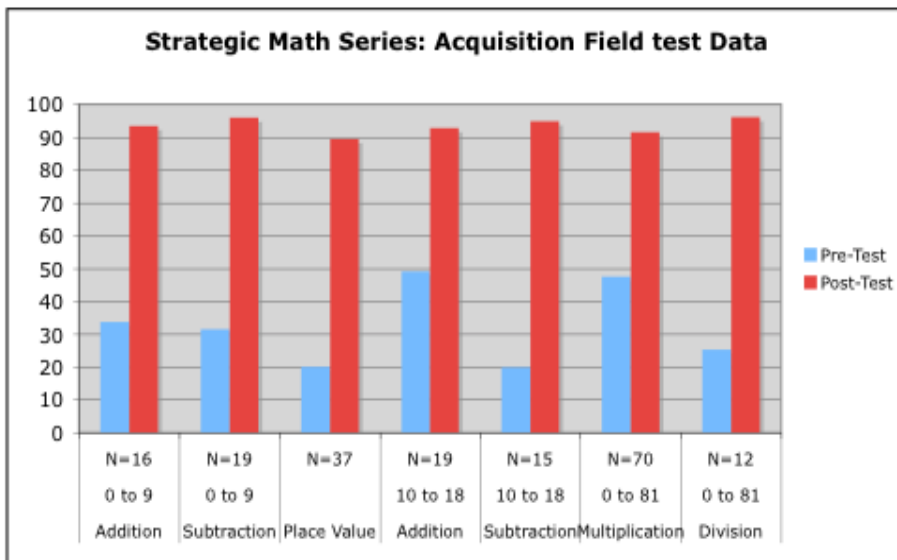
### Overview

Multiple field tests were conducted that involved 56 teachers and 248 elementary students who were experiencing difficulties learning math. These field tests took place in seven school districts in self-contained, resource, and general education classes. The teachers were trained to use programs in the Strategic Math Series. Different groups of students were taught addition facts, subtraction facts, multiplication facts, division facts, and place value concepts and skills, depending on their needs.

### Results

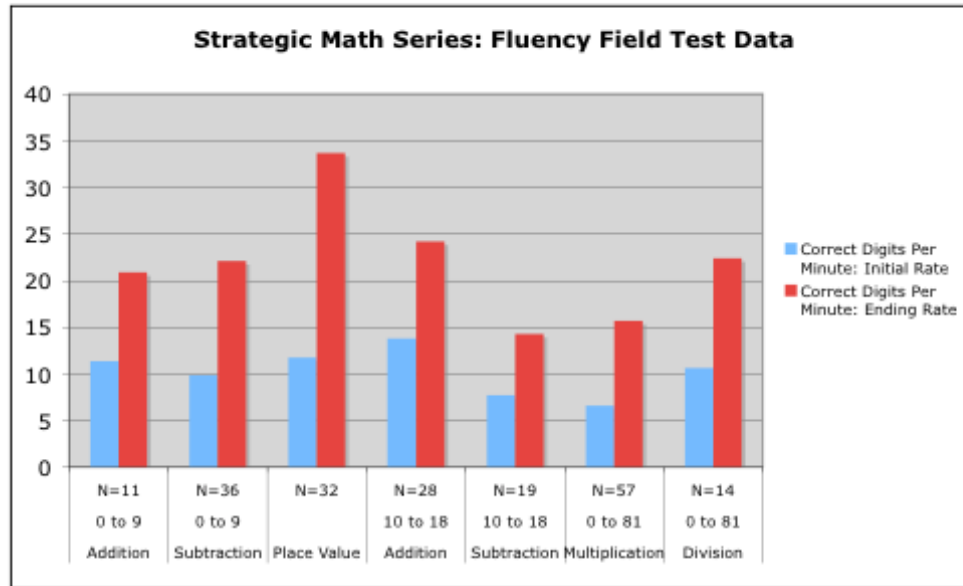
Substantial gains were made by the students in all areas. See the figures below for the results in each math area. Figure 1 shows the results on untimed acquisition tests, and Figure 2 shows the results on timed proficiency tests (i.e., fluency tests). The number of students participating in each field test is shown beneath each pair of bars on the graph.

Figure 1: Percentage of answers correct on untimed acquisition tests



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Figure 2: Percentage of digits correct per minute on fluency tests



The results for the Subtraction Facts 0 to 9 program are shown in the second pair of bar graphs in each figure. For the Subtraction Facts 0 to 9 program, students earned a mean score of 32% on the acquisition pretest and 96% on the posttest. On the fluency test, they produced an average of 10 correct digits per minute in baseline and 22 correct digits per minute after instruction.

## Conclusions

The programs in the *Strategic Math Series* produce substantial gains in student performance on math acquisition and fluency tests across several areas of mathematics. In addition, these programs all produce socially significant final performances with students earning scores around or above the 90% level on acquisition tests in all areas.

## Reference

Miller, S. P., & Mercer, C.D. (1998). *Strategic math series trainer's guide*. Lawrence, KS: Edge Enterprises.